CLAIMS

What is claimed is:

1. A navigational control system for directly altering movement activity of a robotic device operating in a defined working area, comprising:

a transmitting subsystem integrated in combination with the robotic device, the transmitting subsystem comprising

means for emitting a number of directed beams to cover the defined working area, each directed beam having a predetermined emission pattern; and

a receiving subsystem functioning as a base station that includes a navigation control algorithm that defines a predetermined triggering event for the navigational control system and a set of detection units positioned within the defined working area, the detection units being positioned in a known aspectual relationship with respect to one another, the set of detection units being configured and operative to detect one or more of the directed beams emitted by the transmitting subsystem; and wherein the receiving subsystem is configured and operative to

process the one or more detected directed beams under the control of the navigational control algorithm to determine whether the predetermined triggering event has occurred, and, if the predetermined triggering event has occurred

transmit a control signal to the robotic device;

wherein reception of the control signal by the robotic device causes the robotic device to implement a prescribed conduct that alters the movement activity of the robotic device.

2. The navigational control system of claim 1 wherein the emitting means comprises a mechanical sweeping transmitter configured and operative to sweep through a 360° azimuth while sequentially emitting to provide the number of directed beams.

3. The navigational control system of claim 1 wherein the emitting means comprises a set of transmitting units integrated in combination with the robotic device so that the transmitting units have a predetermined spaced-apart relationship, and wherein the transmitting units of the set are operative to provide the number of directed beams.

4. The navigational control system of claim 1 wherein the predetermined emission pattern of the emitted directed beams and the number of beams are correlated so that the transmitting subsystem emulates an omnidirectional transmitting source covering the defined working area.

5. The navigational control system of claim 1 wherein the emitting means is configured and operative to emit the directed beams at a common operating frequency.

6. The navigational control system of claim 5 wherein the emitting means is operative to cyclically modulate the common operating frequency of the directed beams.

7. The navigational control system of claim 1 wherein the emitting means is sequentially cycled on and off.

8. The navigational control system of claim 5 wherein the common operating frequency is an infrared frequency.

9. The navigational control system of claim 5 wherein the transmitting subsystem and the receiving subsystem are synchronized for operation wherein a travel vector for the robotic device is determinable.

10. The navigational control system of claim 9 wherein the transmitting subsystem is operative to

cycle the emitting means on for a predetermined synchronization period and then cycle the emitting means off,

initialize a timing sequence when the emitting means is cycled off, and then

sequentially cycle the emitting means on and off so that the directed beams achieve peak signal strengths at different times with respect to the initialized timing sequence; and wherein the receiving subsystem is operative to

detect one or more of the directed beams emitted by the emitting means during the predetermined synchronization period to identify the predetermined synchronization period;

initialize the timing sequence to synchronize operations with the transmitting subsystem;

identify a peak signal strength for the detected directed beams and a time of detection of the peak signal strength with respect to the timing sequence initialization;

correlate the time of detection of the peak signal strength with the different times at which the directed beams achieve peak signal strength to identify the directed beam having the peak signal strength; and

determine the travel vector of the robotic device based upon the known configuration and operation of the emitting means and the identified directed beam.

11. The navigational control system of claim 9 wherein the transmitting subsystem is operative to

cycle the emitting means on for a predetermined synchronization period and then cycle the emitting means off,

initialize a timing sequence when the emitting means is cycled off, and then

sequentially cycle the emitting means on and off so that the directed beams have a pulsed waveform at different times with respect to the initialized timing sequence; and wherein the receiving subsystem is operative to

detect one or more of the directed beams emitted by the emitting means during the predetermined synchronization period to identify the predetermined synchronization period;

initialize the timing sequence to synchronize operations with the transmitting subsystem;

identify detected pulsed waveforms having a highest and next highest signal strength and times of detection of the highest and next highest signal strengths in terms of the timing sequence initialization;

correlate the times of detection of the highest and next highest signal strengths with the different times of emission of the directed beams to identify the directed beams having the highest and next highest signal strengths;

compute an amplitude ratio for the identified directed beams using the highest and next highest signal strengths; and

use the computed amplitude ratio to a look-up table to determine the travel vector of the robotic device based upon the known configuration and operation of the emitting means and the identified directed beams.

12. The navigational control system of claim 1 wherein the emitting means is configured and operative to emit each directed beam at a unique operating frequency.

13. The navigational control system of claim 12 wherein the receiving subsystem is operative to determine a travel vector for the robotic device based upon the unique operating frequency of the detected directed beam.

14. The navigational control system of claim 12 wherein the emitting means is configured and operative to cyclically modulate the unique operating frequency of each of the directed beams.

15. The navigation control system of claim 12 wherein the receiving subsystem is configured and operative to scan through the unique operating frequencies of the directed beams emitted by the emitting means.

16. The navigational control system of claim 1 wherein the set of detection units comprises a first detection unit, a second detection unit, and a third detection unit, and wherein the first and second detection units are spaced-apart by a known angular distance, the second and third detection units are spaced-apart by a known angular distance, and the first and third detection units are spaced apart by a known angular distance.

17. The navigational control system of claim 1 wherein the set of detection units comprises a first detection unit and a second detection unit spaced apart by a known angular distance.

18. The navigational control system of claim 3 wherein the set of transmitting units comprises eight transmitting units.

19. The navigational control system of claim 18 wherein the predetermined emission pattern of the directed beam emitted by each of the eight transmitting units is approximately one hundred degrees.

20. The navigational control system of claim 1 wherein the prescribed conduct comprises one or more basic maneuvers.

21. The navigational control system of claim 20 wherein the one or more basic maneuvers are selected from a group of maneuvers consisting of clockwise turns, counterclockwise turns, forward movement, and aft movement.

22. The navigational control system of claim 1 wherein the prescribed conduct comprises one or more behavioral modes.

23. The navigational control system of claim 22 wherein the one or more behavior modes are selected from a group of behavioral modes consisting of a spot coverage behavioral mode, an obstacle-following behavioral mode, and a room coverage behavioral mode.

24. The navigational control system of claim 1 wherein the prescribed conduct comprises a combination of one or more basic maneuvers and behavioral modes.

25. The navigational control system of claim 1 wherein the navigation control algorithm comprises a set of instructions for creating a position history based upon the movement activity of the robotic device, and wherein the predetermined triggering event is defined in terms of the position history.

26. The navigational control system of claim 16 wherein the receiving subsystem is configured and operative to

segment the defined working area into a plurality of cells that define a grid map of the defined working area referenced to the receiving subsystem;

process signals representative of detection of the one or more directed beams over a time interval to determine a set of instantaneous positions representing the movement activity of the robotic device;

correlate the set of instantaneous positions with the grid map to identify a set of cells from the grid map corresponding to the set of instantaneous positions wherein the set of cells is the position history; and

implement the navigation control algorithm to evaluate the position history to determine whether the predetermined triggering event has occurred.

27. The navigational control system of claim 26 wherein each of the instantaneous positions comprises a bearing parameter and a distance parameter of the robotic device with respect to the receiving subsystem.

28. The navigational control system of claim 1 wherein the navigation control algorithm comprises a set of instructions for determining an instantaneous position of the robotic device, and wherein the predetermined triggering event is defined in terms of the instantaneous position.

29. The navigational control system of claim 28 wherein the receiving subsystem is operative to

process signals representative of detection of the one or more directed beams to determine the instantaneous position of the robotic device within the defined working area; and

implement the navigation control algorithm to determine whether the instantaneous position of the robotic device is the predetermined triggering event.

30. The navigational control system of claim 29 wherein the instantaneous position comprises a bearing parameter and a distance parameter of the robotic device with respect to the receiving subsystem.

31. A navigational control system for directly altering movement activity of a robotic device operating in a defined working area, comprising:

a transmitting subsystem comprising a distributed set of transmitting units located within the defined working area, each transmitting unit being configured and operative to emit a directed beam having a predetermined emission pattern at a unique operating frequency; and

a receiving subsystem integrated in combination with the robotic device that includes a navigation control algorithm that defines a predetermined triggering event for

the navigational control system, the receiving subsystem including means for detecting the directed beams emitted by the transmitting subsystem; and wherein the receiving subsystem is configured and operative to

process the detected directed beams under the control of the navigational control algorithm to determine whether the predetermined triggering event has occurred, and, if the predetermined triggering event has occurred

communicate a control signal to the robotic device;

wherein reception of the control signal by the robotic device causes the robotic device to implement a prescribed conduct that alters the movement activity of the robotic device.

32. The navigational control system of claim 31 wherein the emitting means comprises an omnidirectional detector that is configured and operative to scan through the unique operating frequencies emitted by the distributed set of transmitting units.

33. The navigational control system of claim 31 wherein the distributed set of transmitting units comprises a first transmitting unit operating at a first unique operating frequency and a second transmitting unit operating at a second unique operating frequency.

34. The navigational control system of claim 31 wherein the prescribed conduct comprises one or more basic maneuvers.

35. The navigational control system of claim 34 wherein the one or more basic maneuvers are selected from a group of maneuvers consisting of clockwise turns, counterclockwise turns, forward movement, and aft movement.

36. The navigational control system of claim 31 wherein the prescribed conduct comprises one or more behavioral modes.

37. The navigational control system of claim 36 wherein the one or more behavior modes are selected from a group of behavioral modes consisting of a spot coverage behavioral mode, an obstacle-following behavioral mode, and a room coverage behavioral mode.

38. The navigational control system of claim 31 wherein the prescribed conduct comprises a combination of one or more basic maneuvers and behavioral modes.